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Title:

ELECTRICAL GROUNDING ASSEMBLY FOR A CONTROL VALVE

Peter K. Merrill	a citizen of the United States, residing at 19 Park Avenue, Greenland, New Hampshire 03840
Joel R. Anderson	a citizen of the United States, residing at 174 Old Sanford Road, Berwick, Maine 03901

ELECTRICAL GROUNDING ASSEMBLY FOR CONTROL VALVE

TECHNICAL FIELD

[0001] The electrical grounding assembly described herein makes known a device to substantially eliminate the electric potential difference between components within a control valve. More specifically, an electrical grounding assembly is disclosed having an arrangement that significantly reduces installation expense and substantially decreases maintenance intervals by creating a shared electrical connection between electrically isolated control valve components within the control valve.

BACKGROUND

[0002] Control valves are commonly used to control fluid flow through a pipe. As known to those skilled in the art, a control valve regulates the rate of fluid flow as an actuator changes the position of a moveable operator or valve trim within the control valve. Certain process fluids may be very corrosive to the control valve. To counteract the effects of the corrosive process fluid, control valve manufacturers may select special materials that are generally impervious to the corrosive effects of the process fluid. For example, nickel alloy UNS N10276 is known to have superior corrosion resistance to a wide range of corrosive agents. Using special corrosion resistant alloys, particularly in valve bodies, can be cost prohibitive for less expensive valves like butterfly-style control valves. Valve manufacturers generally address this cost issue by supplying the valve body with a corrosion resistant, non-conductive liner.

[0003] The advantage of a lined valve is that the valve body is not wetted by the process fluid and therefore can be made from less expensive materials when used in corrosive applications. Valve body liners are typically made from elastomers such as ethylene propyl terpolymer (EPDM). These elastomers are typically non-conductive and have dielectric properties. As known to those skilled in the art, the dielectric material substantially insulates the valve trim from the valve body effectively creating a capacitor that may store an electrostatic charge. Additionally, numerous control valve applications do not use packing materials, seals, and/or guide bushings that have conductive properties. Therefore, if the valve trim is not positively grounded to the valve body with a shared electrical connection, fluid flow through the valve body and across the valve trim may create an electrostatic charge transfer that can accumulate similar to a capacitor accumulating an electrostatic charge. The accumulating charge can establish a potential difference of several thousand volts between the valve body and valve trim. As is known, when the accumulated charge exceeds the breakdown voltage of the dielectric or insulator, an arc may result. Also, if a momentary discharge path is created between the valve body and the valve trim, for example a wrench being used during routine maintenance, an arc could be struck. As a result, numerous industry standards and governmental regulations require that equipment used in an explosive atmosphere shall be designed to operate safely in that atmosphere. The equipment, including mechanical devices such as valves, must be free of sources that may lead to ignition of the surrounding atmosphere.

[0004] Typical solutions include the use of external grounding straps between valve components and conductive packing. Due to cost, however, these solutions are not applicable to all control valve designs. External straps can also be severed during operation subsequently creating an ignition source at the control valve. Lastly, known

to those skilled in the art, the external surfaces of valve bodies and actuators are typically painted with a powder-coated paint that provides an extremely durable, scratch resistant coating that also functions as an insulator. Therefore, conventional assemblies require manual removal of the paint from conductive surfaces to provide a shared electrical connection between the valve components. In a manufacturing operation, these manual operations are time consuming and expensive.

SUMMARY

[0005] Accordingly, it is the object of the electric grounding assembly to substantially eliminate the electric potential between control valve components used in potentially explosive atmospheres. More specifically, the present electrical grounding assembly places an elastic grounding connector in an outboard bearing hole of a control valve creating a shared electrical connection between the valve trim and the valve body.

[0006] In accordance with one aspect of the present electrical grounding assembly, an electrically conductive, deformable ball is located in a bore within the valve body. The deformable ball is made from stranded metal wire. Upon assembly, the valve trim compresses the deformable ball making contact with the valve trim and valve body thereby creating a shared electrical connection between the valve trim and the valve body.

[0007] In accordance with another aspect of the present electrical grounding assembly, a conical metal spring is located in a bore within the valve body between the valve trim and the valve body creating a shared electrical connection within the control valve.

BRIEF DESCRIPTION OF THE DRAWINGS

[0008] The features of this present electrical grounding assembly are believed to be novel and are set forth with particularity in the appended claims. The present electrical grounding assembly may be best understood by reference to the following description taken in conjunction with the accompanying drawings in which like reference numerals identify like elements in the several figures and in which:

FIGURE 1 is a cross-sectioned side view of an elastomer lined butterfly-style control valve with a deformable stranded metal ball providing a shared electrical connector within the control valve.

FIGURE 2 is a partial cross-section side view of an elastomer lined butterfly-style control valve using a conical spring in combination with the stranded metal ball to create a shared electrical connection within the control valve.

FIGURE 3 is a partial cross-section side view of an elastomer lined butterfly-style control valve using a single conical spring to create a shared electrical connection within the control valve.

DETAILED DESCRIPTION

[0009] To fully appreciate the advantages of the present electrical grounding assembly, its functions and features are described in connection with a butterfly-style control valve. However, one skilled in the art would appreciate the present electrical grounding assembly could be used in other types of valves.

[0010] Referring now to Figure 1, a cross-sectioned side view of an elastomer lined butterfly-style control valve is depicted with a deformable stranded metal ball providing a shared electrical connection within the control valve. The butterfly-style

control valve 10 is comprised of a valve body 12 and the valve trim 15. The valve trim 15 is typically defined as the internal components of the control valve 10 that regulate the flow of the process fluid. In the present embodiment, the valve trim 15 is comprised of a valve shaft 18 and a control disk or vane 20, both being fabricated from non-corrosive stainless steel such as UNS S31600. The control disk 20 is attached to the valve shaft 18 with two taper pins 22a and 22b pressed into alignment holes (not shown) in both the valve shaft 18 and the control disk 20. The process fluid is contained within the valve body 12 by non-conductive valve packing 25 and non-conductive o-ring seals 26a and 26b. A non-conductive guide bushing 30 on the inboard side of the valve body 12 and an outboard-bearing hole 32 align the valve trim 15 within the valve body 12. An actuator (not shown) is fastened to the inboard side of the valve body 12 with actuator bolts (not shown) completing the attachment through the actuator mounting holes 38a and 38b. The actuator directly couples to inboard end 19 of the valve shaft 18 and rotates the valve trim 15 about a longitudinal axis 50 defined by the valve shaft 18. The exterior of the actuator and the valve body 12 are typically painted with a non-conductive powder-coated paint process that insulates the actuator from both the valve body 12 and the valve trim 15.

[0011] A non-conductive elastomer liner 42 concomitantly creates a soft annular seating surface 27 for the control disk 20 to engage during operation and forms a barrier between the valve body 12 and the process fluid. Subsequently, the barrier provided by the elastomer liner 42 electrically isolates the valve trim 15 from the valve body 12. As known to those skilled in the art, the dielectric properties of the elastomer liner 42 effectively establish a capacitor between the valve body 12 and the valve trim 15 that can store an electrostatic charge. The accumulation of the charge may create a safety hazard by presenting an ignition source when used in a potentially

explosive environment. Therefore, the charge must be prevented from accumulating by creating an electrical ground around the capacitor established by the elastomer liner 42.

[0012] As shown in Figure 1, the preferred electrical grounding assembly is comprised of a conductive, stranded metal ball 45 formed to fill the outboard-bearing hole 32 of the valve body 12. The stranded metal ball 45 is fashioned from substantially random windings of stranded metal similar to conventional steel wool. In the preferred embodiment, the stranded metal ball 45 is preferably made from a corrosion resistant metal such as stainless steel S31600, but other corrosion resistant, conductive materials can be used. During assembly of the control valve 10, the valve shaft 18 is placed through the non-conductive guide bushing 30 and the valve packing 25. The stranded metal ball 45 is placed within the outboard bearing hole 32 prior to final installation of the valve shaft 18. Upon final installation, the valve shaft 18 is loaded into the outboard-bearing hole 32 consequently compressing the stranded metal ball 45. Due to the resiliency of stranded metal, the stranded metal ball 45 inherently forms an elastic region within the stranded metal ball that maintains contact between the conductive surface of the stranded metal ball, the bare metallic walls of the outboard-bearing hole 32 in the valve body 12, and the valve trim 15 through the valve shaft 18 during operation of the control valve 10. This shared electrical connection grounds the electrostatic charge accumulation by eliminating the electrical isolation between the valve trim 15 and the valve body 12.

[0013] Unlike conventional external grounding straps that provide a single connection point, the numerous strands of metal within the stranded metal ball 45 maintain a plurality of electrical contact points between the outboard bearing hole 32 and the valve trim 15, thereby providing an improved shared electrical connection.

Additionally, by maintaining an internal shared electrical connection within the control valve 10, the potential for catastrophic failure of the connection due to physical separation is substantially eliminated. The preferred electrical grounding assembly also reduces assembly time and saves manufacturing costs by eliminating the need to manually remove paint to expose conductive surfaces and eliminates the drilling and tapping of bolt holes to attach an external grounding strap.

[0014] Turning now to Figure 2, an elastic grounding connector according to another embodiment of the present electrical grounding assembly is depicted. For a butterfly-style control valve 110 with a deep outboard bearing hole 132, as depicted, the stranded metal ball 145 can be biased towards the outboard end 125 of the valve shaft 118 with a helical bias spring 148. The helical bias spring 148 compensates for variations in depth of the outboard-bearing hole 132 and will assure that the stranded metal ball 145 stays in contact with the valve shaft 118 in applications where the valve shaft 118 can oscillate along its longitudinal axis 150.

[0015] In Figure 3, another embodiment of the elastic grounding connector of the present electrical grounding assembly is illustrated. A single conical spring 248 is placed in the outboard-bearing hole 232. The spring 248 makes contact between the outboard end 225 of the valve shaft 218 and the valve body of 212 through the bare metallic surface of the outboard-bearing hole 232. As known to those skilled in the art, the conical winding of the spring 248 is formed such that the outboard end 255 of the spring 248 is slightly larger than the diameter of the outboard-bearing hole 232 to retain the spring 248 in the outboard-bearing hole 232 during assembly.

[0016] The foregoing detailed description has been given for clearness of understanding only, and no unnecessary limitations should be understood therefrom, as modifications will be obvious to those skilled in the art. For example, it can be

appreciated by those skilled in the art that the present electrical grounding assembly is not limited to spherical or ball shaped geometry, but may assume any shape to fill the outboard-bearing hole to create a shared electrical connection. Furthermore, one skilled in the art can further appreciate the elastic connector could be permanently attached to the outboard end of the valve shaft with a screw or rivet to ensure constant contact between the valve trim and the valve body.